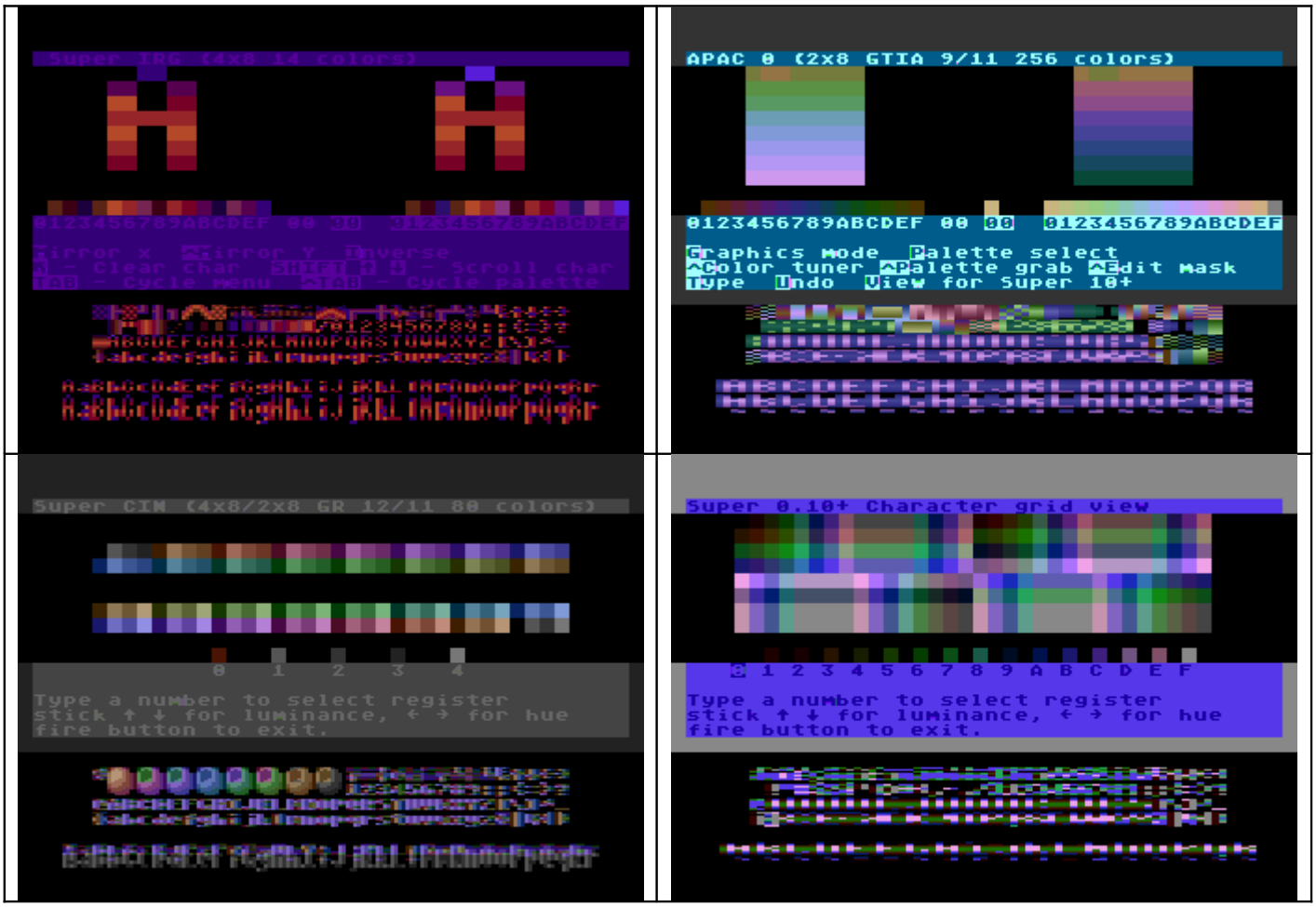
INTERLACE CHARACTER EDITOR (ICE)

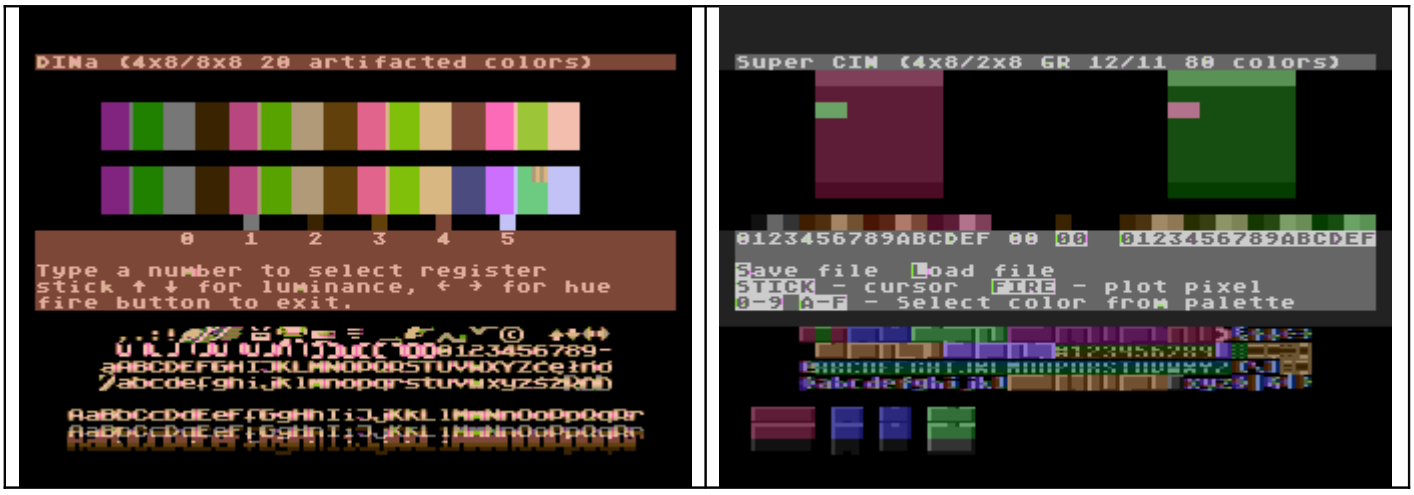
Programmed by Bobby Clark

Version 1.0 for the ABBUC Software Contest 2011



INTRODUCTION

Interlace Character Editor (ICE) is a collection of three font editors written in Turbo BASIC for the Atari 8-bit (XL/XE) computer. Unlike other font editors, ICE designs fonts for use in special software character-flip modes which allow for the display for more colors onscreen than in normal Atari graphics modes.



REQUIREMENTS

To run the editor programs you will need:

An Atari XL/XE computer with at least 48K RAM, or an emulator (Altirra is recommended)

Joystick controller

ICE will not run on an older Atari such as an Atari 400/800. It is also not recommended to use the Atari800Win emulator when running ICE, as there is an issue with some of the special graphics modes not displaying properly.

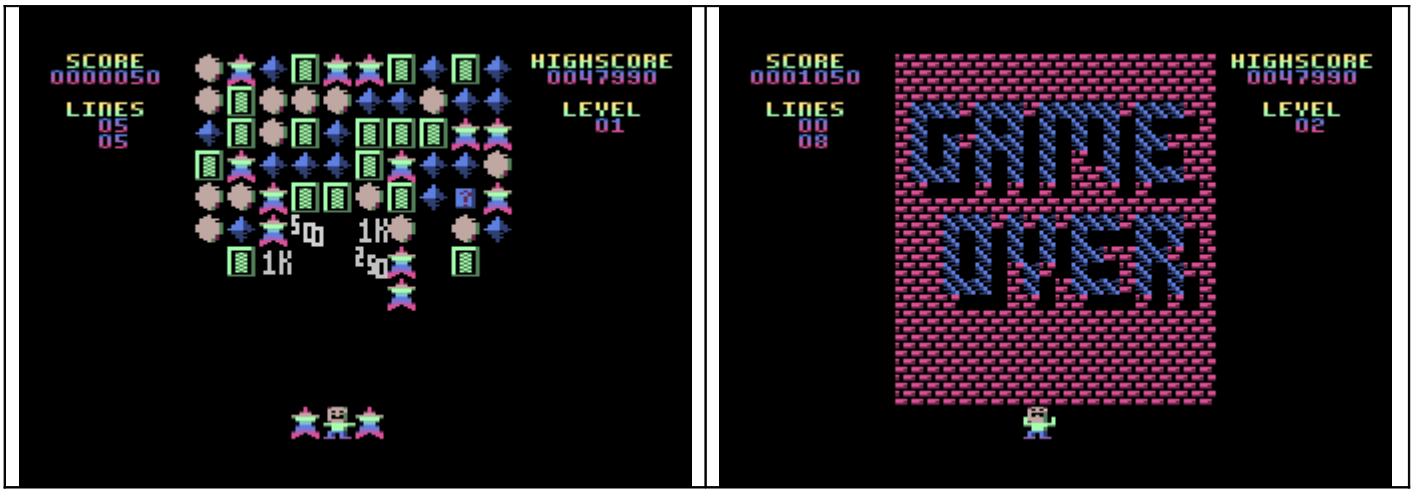
When using Altirra, if you read and write files from the H: device, be sure to disable Burst I/O. Also set the video display for Frame Blending to

reduce flicker. The custom display modes ICE uses will also look better on NTSC Ataris due to the faster refresh rate (60 times a second).

INTRODUCTION TO CHARACTER FLIP MODES

ICE creates fonts for use in special software graphics modes known as character flip modes. These special display modes allow for the display of additional colors onscreen, by flipping character sets, color registers, and/or graphics display modes onscreen at a fast rate. The persistence of vision of the human eye allows the perception of extra colors.

The first usage of this type of display mode on the Atari 8-bit computer was by Atari programmer Bill Kendrick in 1998. He wrote a puzzle game called Gem Drop that used a special software display mode he named Super IRG. The display mode is based out of ANTIC 4 (Graphics 12) but allows for the display of 14 colors onscreen at once.



The extra colors are achieved through an Atari routine known as a Vertical Blank Interrupt. The VBI is a series of machine code instructions the Atari executes everytime the TV screen has been drawn. This code is executed 60 times per second (50 times per second on European PAL Ataris).

During a VBI it is possible to switch character sets, color registers, and graphics mode display settings. The fast cycle rate (up to 60 times a second) allows the colors to blend together, creating the illusion of extra colors onscreen.

A further experimentation of Bill Kendrick's technique has produced a total of 20 software display modes, which are supported in the ICE editor. These display modes are divided into three categories: IRG modes, GTIA modes, and CIN modes.

IRG Modes

These are display modes that are based off of a Graphics 0 or Antic 4/5 (Graphics 12/13) text display. There are four of these modes currently supported in the ICE editors:

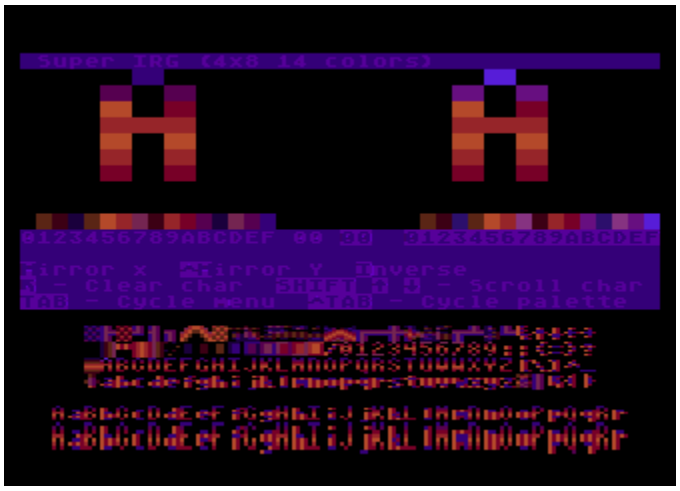
Super 0

This display mode is created by the flipping of two Graphics 0 fonts onscreen, and also by flipping the color registers 710 and 709 every

VBLANK. The result is an 8x8 character display which can display 4 colors per character.

The Atari TV display in Graphics 0 uses a high pixel resolution (320 pixels across) that creates color artifacts on a normal TV screen or RGB monitor. When these are taken into account, 16 colors can be perceived in each character grid.

Super IRG

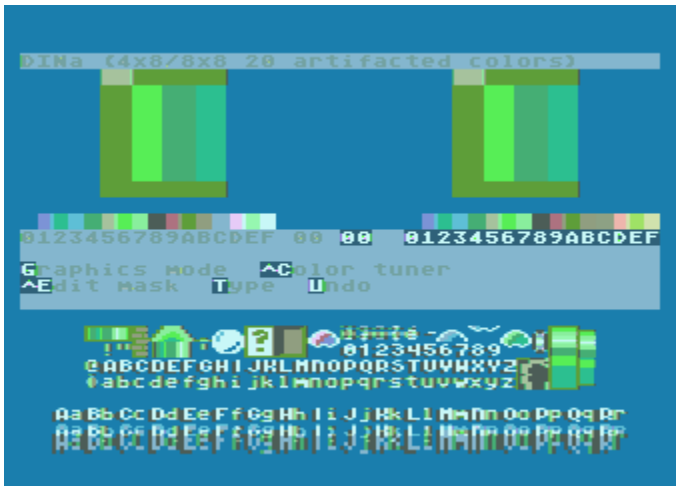


This display mode was used in Bill Kendrick's Gem Drop game. It is based out of an ANTIC 4/5 (Graphics 12/13) display and a 4x8 character grid. The character set is flipped every VBLANK, allowing for 10 colors to be displayed in each character grid. Using inverse characters allows for an extra 4 colors, allowing for a total of 14 colors onscreen at once.

Super IRG 2

This is a modification of the Super IRG mode, except that in addition to the character set, the playfield registers 708-711 are also color shifted each VBLANK. This allows 16 colors per character grid, 23 total colors when inverse characters are taken into account.

DIN (Display Interface)



This display mode flips between two display lists stored in memory: Graphics 0 and ANTIC 4 (Graphics 12). The pixel resolution is 320 across, in an 8x8 character grid, but 10 colors can be displayed onscreen

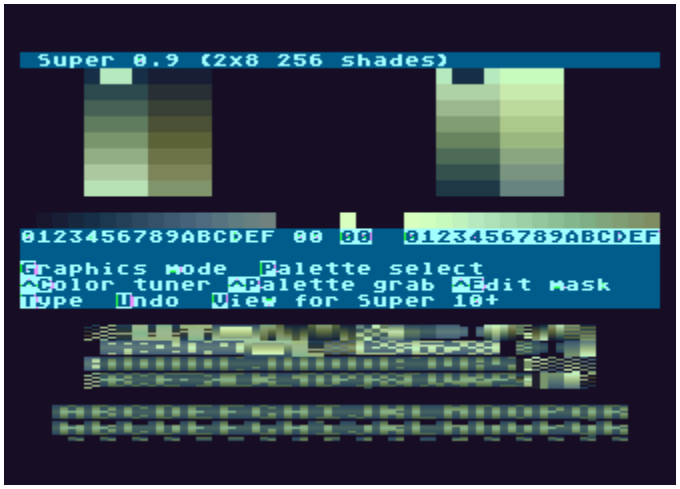
at once. When artifacting in Graphics 0 is taken into account, 20 colors can be perceived.

GTIA Modes

These display modes are based off of the GTIA graphics modes (Graphics 9-11). It is possible to set these modes in text mode, through the GTIA register at memory location 623. This leads to a 2x8 character grid at 80 pixel resolution, with 16 possible color combinations per pixel.

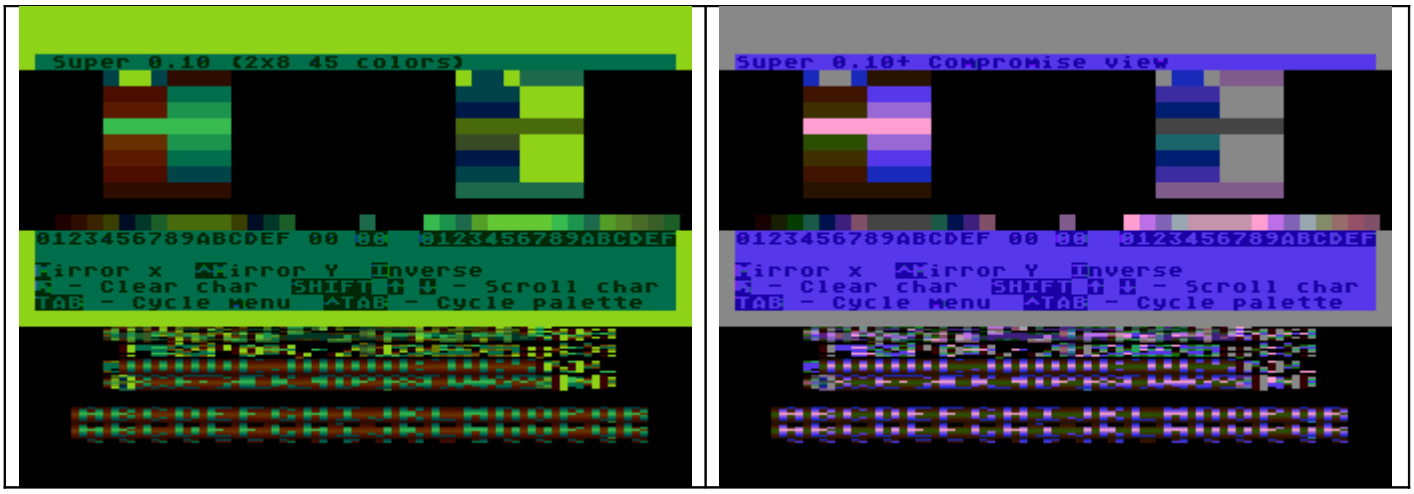
The GTIA display modes involve a character set flip, and in some cases the GTIA setting is changed every VBI as well.

Super 9



This is based off of Graphics 9, the 16 shade monochrome mode. The character set, and register 712 (background and shade hue) are changed every VBLANK, giving off 256 duo-tone shades.

Super 10 and Super 10+



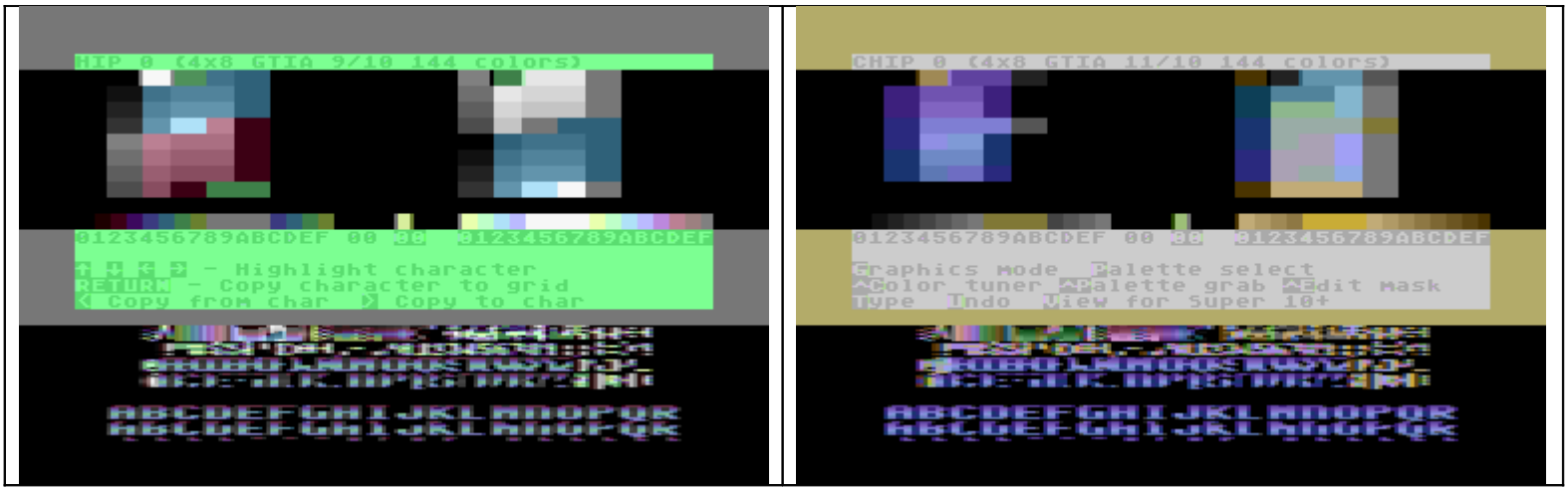
This is based off of the paletted mode 10, which has 9 colors programmable from the playfield and player color registers (704-712). In Super 10, a character set shift produces 45 colors onscreen at once.

Super 10+ modifies this display by adding a color register flip of registers 705-711, increasing the color resolution to 80 colors.

Super 11

This is based off of Graphics 11, the 16 chroma mode. By flipping character sets and register 712 (which controls the luminance of the colors) a total of 256 colors at three luminances can be seen.

HIP 0 and CHIP 0



These modes are inspired by a bitmap mode called Hard Interlaced Picture (HIP). The concept is an alternating of Graphics 10 with one of the other GTIA modes every VBLANK. There is a quirk in the Atari's graphics display hardware which causes the Graphics 10 pixels to shift ½

color clock (or ½ a GTIA pixel) to the right. This causes the illusion of 160 pixel resolution.

HIP 0 combines Graphics 9 with 10 in text mode, while CHIP 0 combines Graphics 11 with 10. A total of 144 colors can be perceived onscreen at an apparent resolution of 160 pixels across.

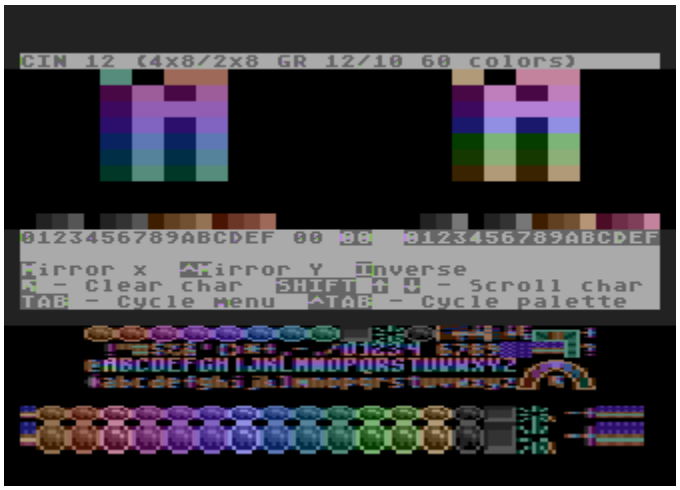
APAC 0

This is the text equivalent of the APAC mode, a combination of Graphics 9 (16 shades) with Graphics 11 (16 chroma). A total of 256 resultant colors can be perceived onscreen at once.

CIN Modes

These modes are inspired by the Champions Interlace (CIN) bitmap mode. The concept is an alternating of a GTIA mode with a Graphics 0 or ANTIC 4/5 (Graphics 12/13) text mode.

CIN 12



This is one of the most useful CIN modes. An ANTIC 4/5 display list is used and the GTIA is flipped between normal and Graphics 11. 36 colors can be used per character grid, with the usage of inverse characters bringing the total color resolution to 60 colors. Although not required, it is good practice to use monochrome colors for registers 708-711, which interface with the 14 hues accessible in this mode

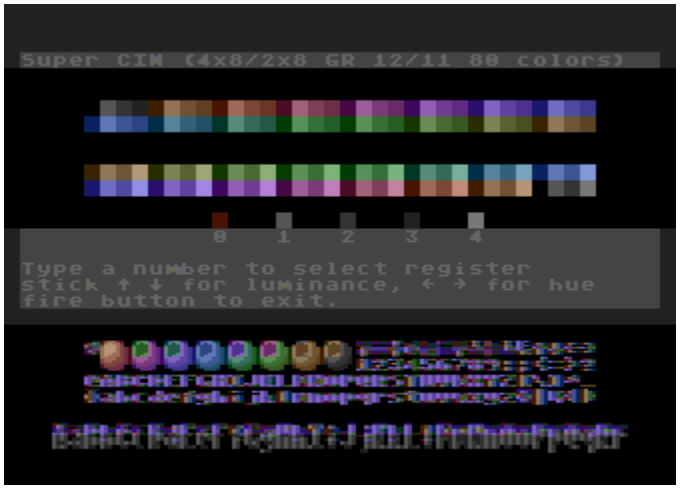
MIN 12

This is analogous to the CIN 12 mode above, except that the GTIA is shifted into Graphics 9 every VBLANK. 9 level shading is available per each character, with brighter shades available for inverse characters. 60 colors total can be displayed onscreen at once.

PCIN 12

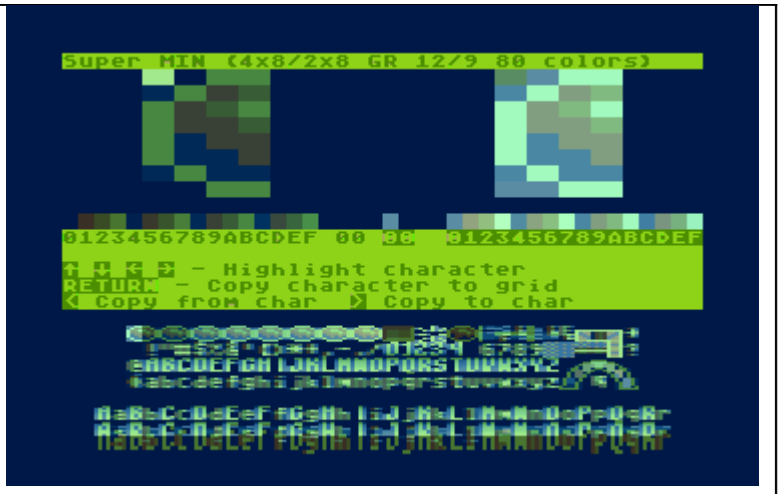
This mode shifts the GTIA into Graphics 10, the paletted mode. The colors are controlled from registers 705-711 and a total of 34 colors can be perceived onscreen at once.

Super CIN



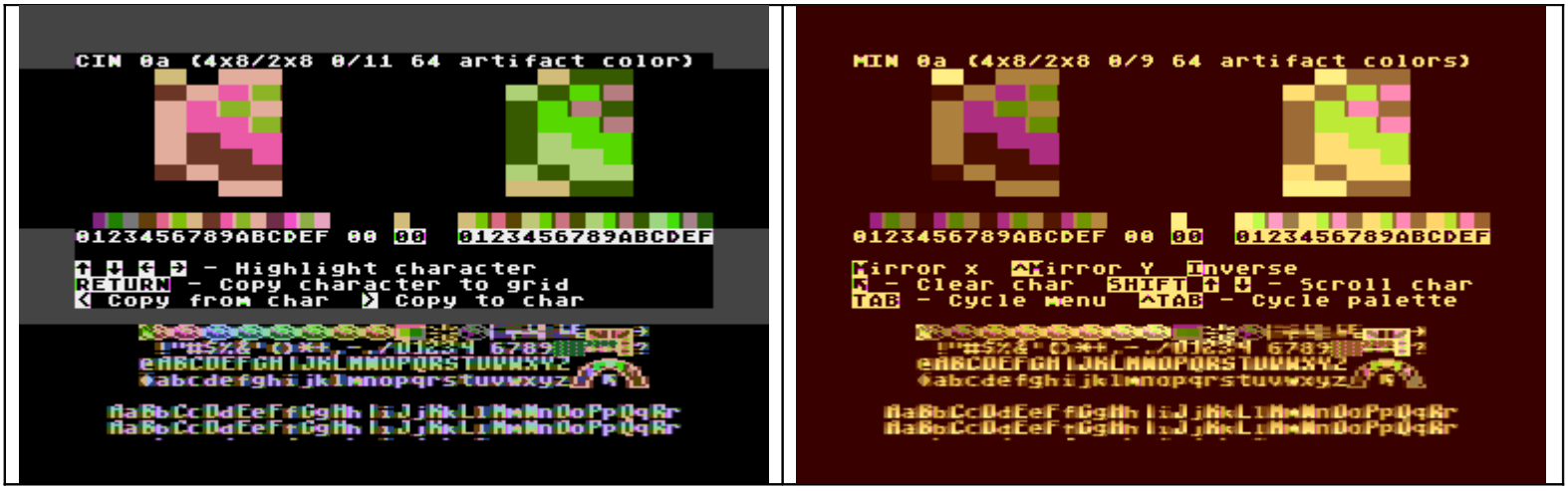
This is a modification of the CIN 12 mode. A display list shift from Antic 4 to Graphics 0 combined with a GTIA shift to Graphics 11 increases the color resolution to 80 colors onscreen at once at ANTIC 4 resolution. This mode is unusable in ANTIC 5 (40x12).

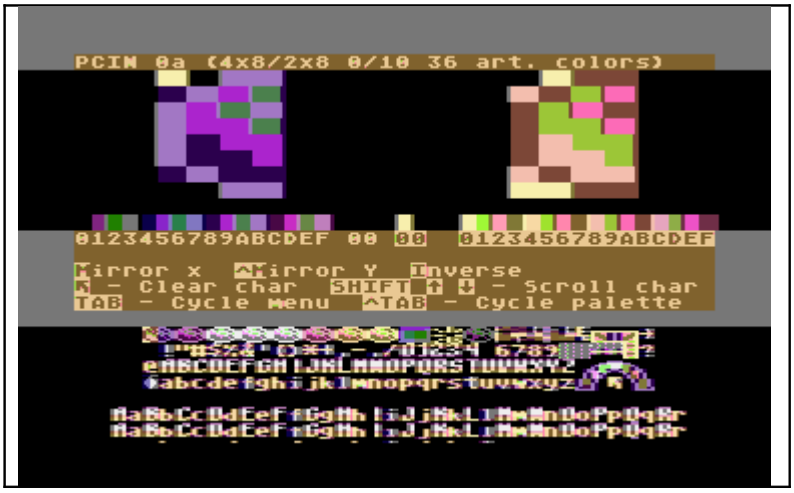
Super MIN and Super PCIN



Similar to Super CIN, a display list shift is added to increase color resolution. Super MIN increases to 80 colors, while an additional color is gained in Super PCIN, along with a better color palette layout.

CIN 0, MIN 0, and PCIN 0





These three display modes mix a Graphics 0 screen with one of the GTIA settings. The result is a 2x8 GTIA character grid, which can also display 4 Graphics 0 pixels. 18 to 32 colors can be seen onscreen at Graphics 0 resolution, and this number is doubled when Graphics 0 artifacting is taken into account.

The ICE Editor programs

There are three different editors; each one is on a separate disk or .ATR:

ICE IRG: Edits in the Super 0 / Super IRG / DIN modes

ICE GTIA: Edits in the GTIA modes

ICE CIN: Edits in the CIN/MIN/PCIN modes

To run the editor, insert the appropriate disk and boot your Atari computer or emulator. After the welcome screen, press any key and you will be delivered to the main editor screen.

The Main Editor Screen

This is the main ICE screen. It is divided into several areas:

The top line is a status area that displays the current Graphics mode. Two character grids are shown, a normal grid on the left, and an inverse grid on the right that shows how the character will look when inversed.

Below the grids are two 16-color palettes from which drawing colors can be selected, along with a block that indicates the current drawing color.

Below the color palette display is a 4-line menu display that shows the commands you can use. The TAB key will cycle this menu display.

Next is the character set display, which shows all 128 characters, from which you can select a character to edit.

The bottom two lines are the typing area, where characters can be typed. Two lines are shown, with the top line displaying in ANTIC 2 or 4, and the bottom line in ANTIC 3 or 5.

Editing your character

The first step to editing your character is to select a character to edit from the character set grid by using the arrow keys (ctrl+arrow) to move the cursor around the character set display.

Note that if you are in a non-Antic 2 mode such as CIN 12, the display list will change in the character set area, so that you can see the cursor more clearly (here highlighted over the “A” character). Hit RETURN to select the character and copy it to the character grid.

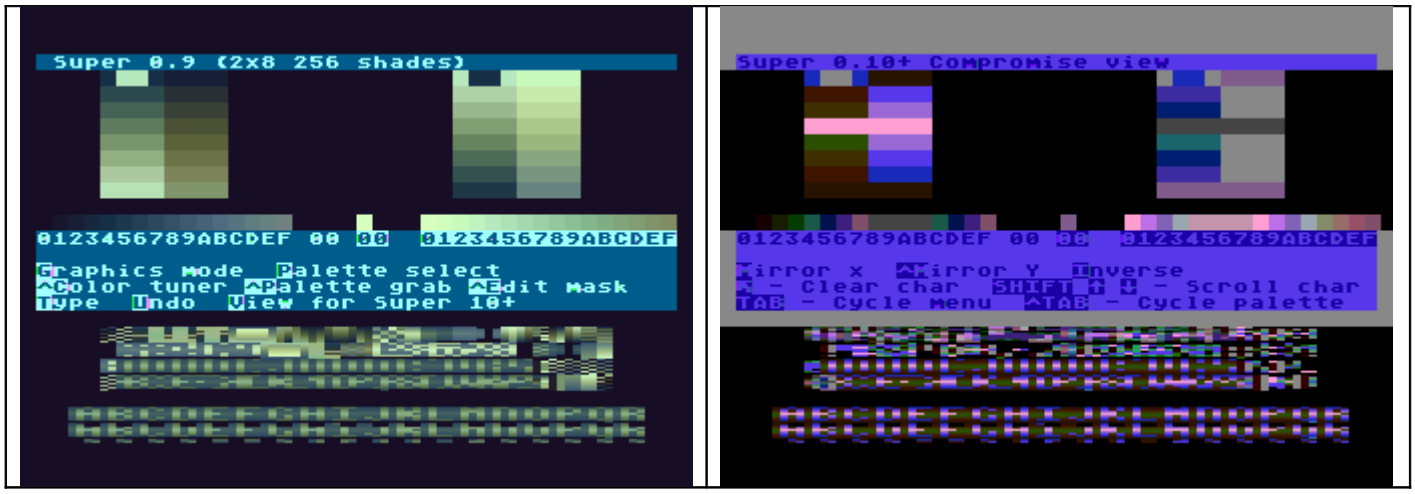
Use your Joystick (plugged into port 0) to move your editing cursor. There are actually 2 cursors, one on the normal grid on your left, and on the inverse character grid on the right.

The character grid you use will be different, depending on which mode you are editing in. In the IRG modes (ICE IRG only), you have a simple 4x8 character grid:

Each pixel on the grid can contain any of 16 colors, although some colors will be redundant. Some colors are different on the inverse palette, and in addition, identical color pairs in Super IRG can be offset from each other to create a dithering pattern to reduce flicker.

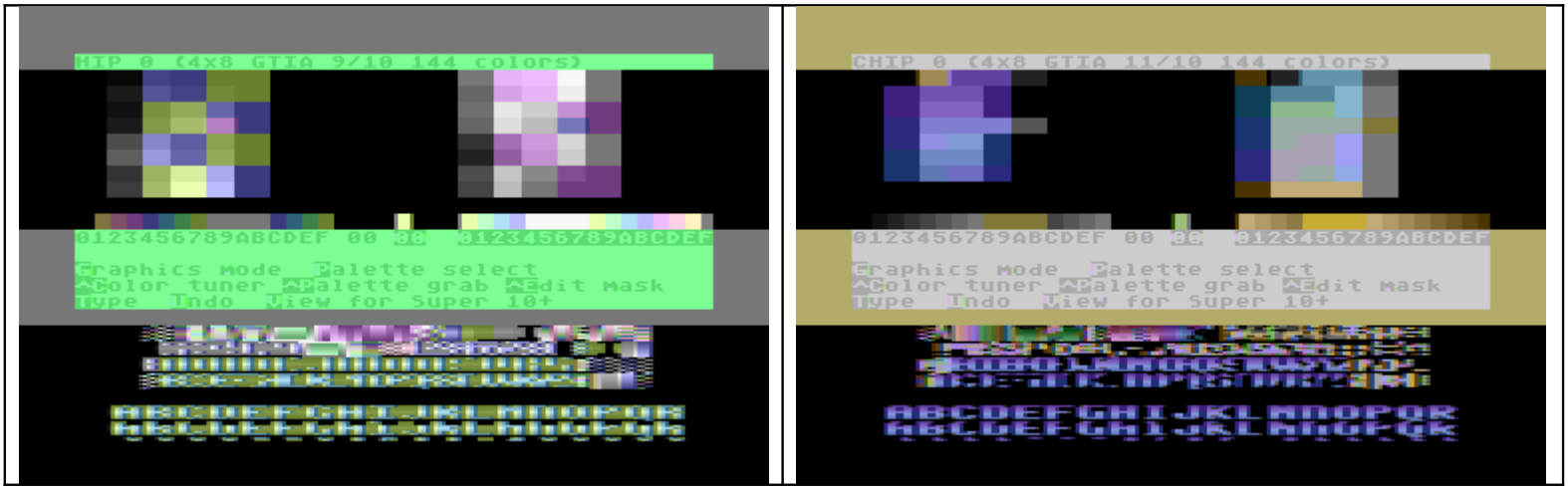
The Super 0 and DIN modes support editing in artifacted mode (4x8). A future release will add non-artifacted (8x8) editing mode.

In the GTIA modes (ICE GTIA only), you get a 2x8 character grid:



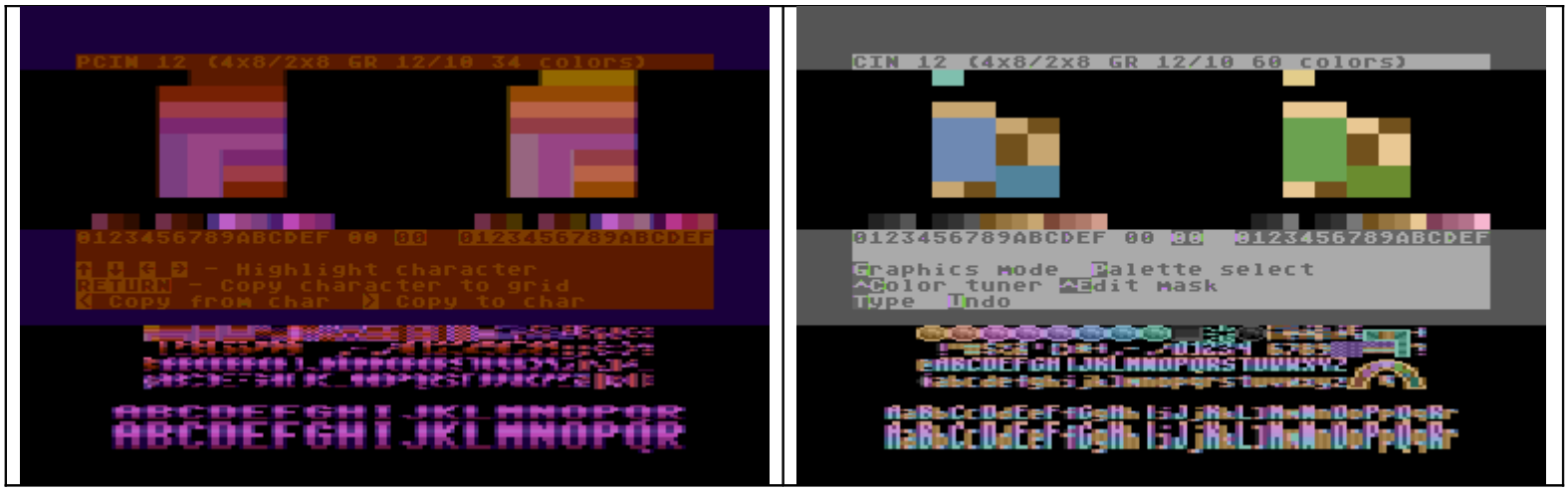
Each pixel on the grid can hold any of 256 color values. In modes based on Graphics 10 (Super 10, Super 10+, HIP 0 and CHIP 0) some of these colors will be redundant. Also, in Super 10, you can use identical color pairs in a dithering pattern similar to Super IRG

If you are editing in the HIP/CHIP modes (ICE GTIA only) you will notice a shifted grid, which is to imitate the pixel-shifted nature of these modes:



In this case, the mode 10 mask has been shifted to the right. You are still editing in only 2 columns (as in the other GTIA modes) but the pixel you plot will affect the properties of pixels in neighboring columns on the display.

The CIN modes (ICE CIN only) give you a combined 2x8/4x8 grid:



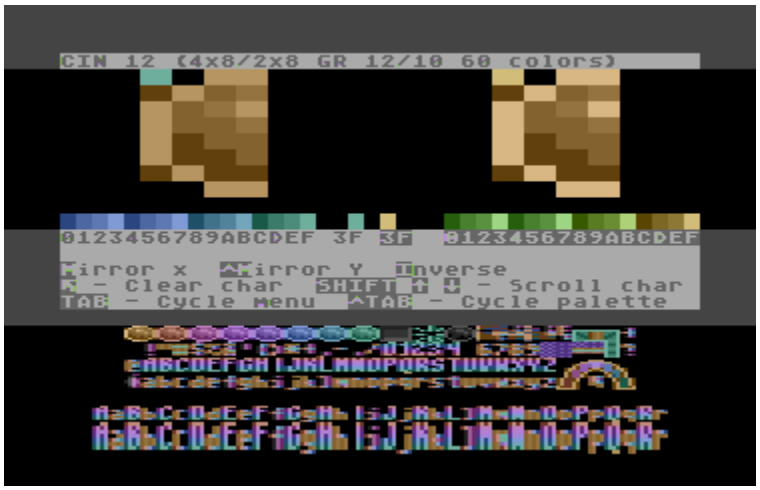
The Antic 4 data occupies a 4x8 grid, but as this mode is paired with a GTIA mode, this means that the GTIA color data will automatically occupy a 2x8 space on the grid. For example, in the CIN 12 grid above you will notice that while each 4x8 pixel is a monochrome value, every two pixels shares the same chroma value which is derived from the GTIA overlay.

In all, you have a total of 64 colors at your disposal in each grid, although in the PCIN modes many of these colors are redundant due to the Graphics 10 palette layout.

In the PCIN modes, registers 708-711 are shared between Antic 4 and the GTIA 10 modes, so a 2x8 dithering pattern can be used in your character, by selecting identical color pairs.

In the CIN 0/MIN 0/PCIN 0 modes, artifacting is used. A future version of this editor will allow editing in nonartifacting (8x8/2x8) mode.

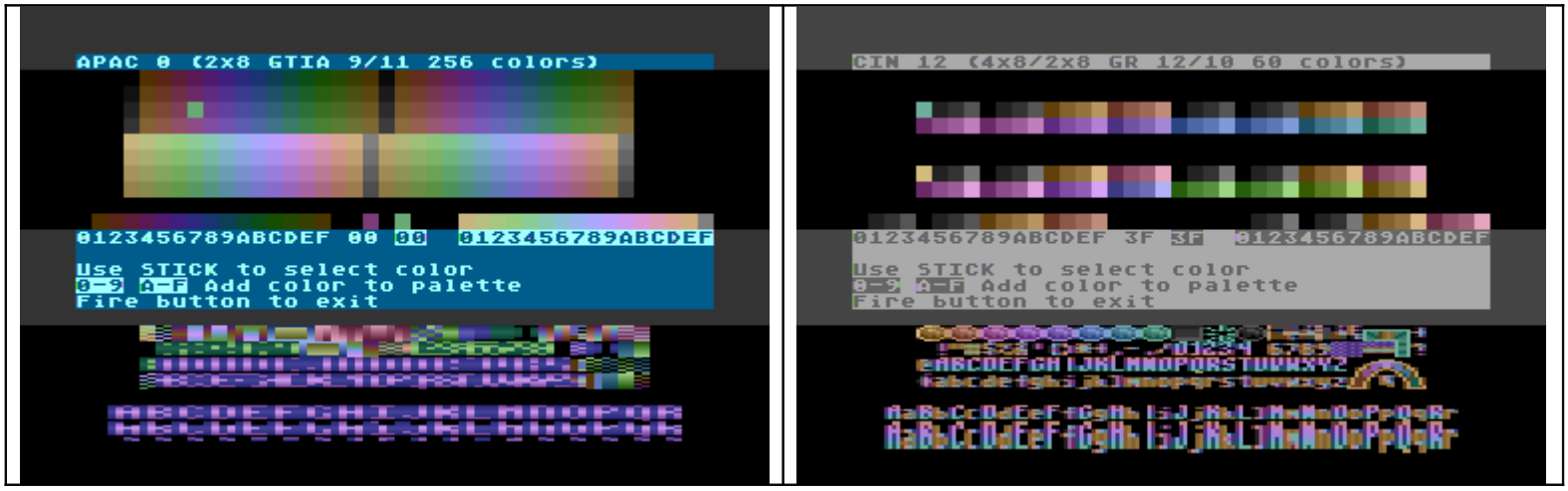
Select drawing color from palette



Typing in 0-9 or A-F will select a color from your drawing palette. The selected color will appear in the color select area between the normal and inverse palettes, and shows up in both normal and inverse. In this example color "F" has been selected from the color palette, and appears next to the palette in both normal (light green) and inverse (bright yellow). Below the color selected is a hex code showing the color number. 16 unique colors can be selected in ICE IRG, 64 in ICE CIN, and 256 in ICE GTIA, although in some modes certain colors are redundant.

In ICE CIN and ICE GTIA, doing CTRL-TAB will scroll the color palette allowing you access to additional colors. The color palette itself can store 64 colors, but using the palette select function described below will allow you to add additional colors or rearrange your palette as you see fit.

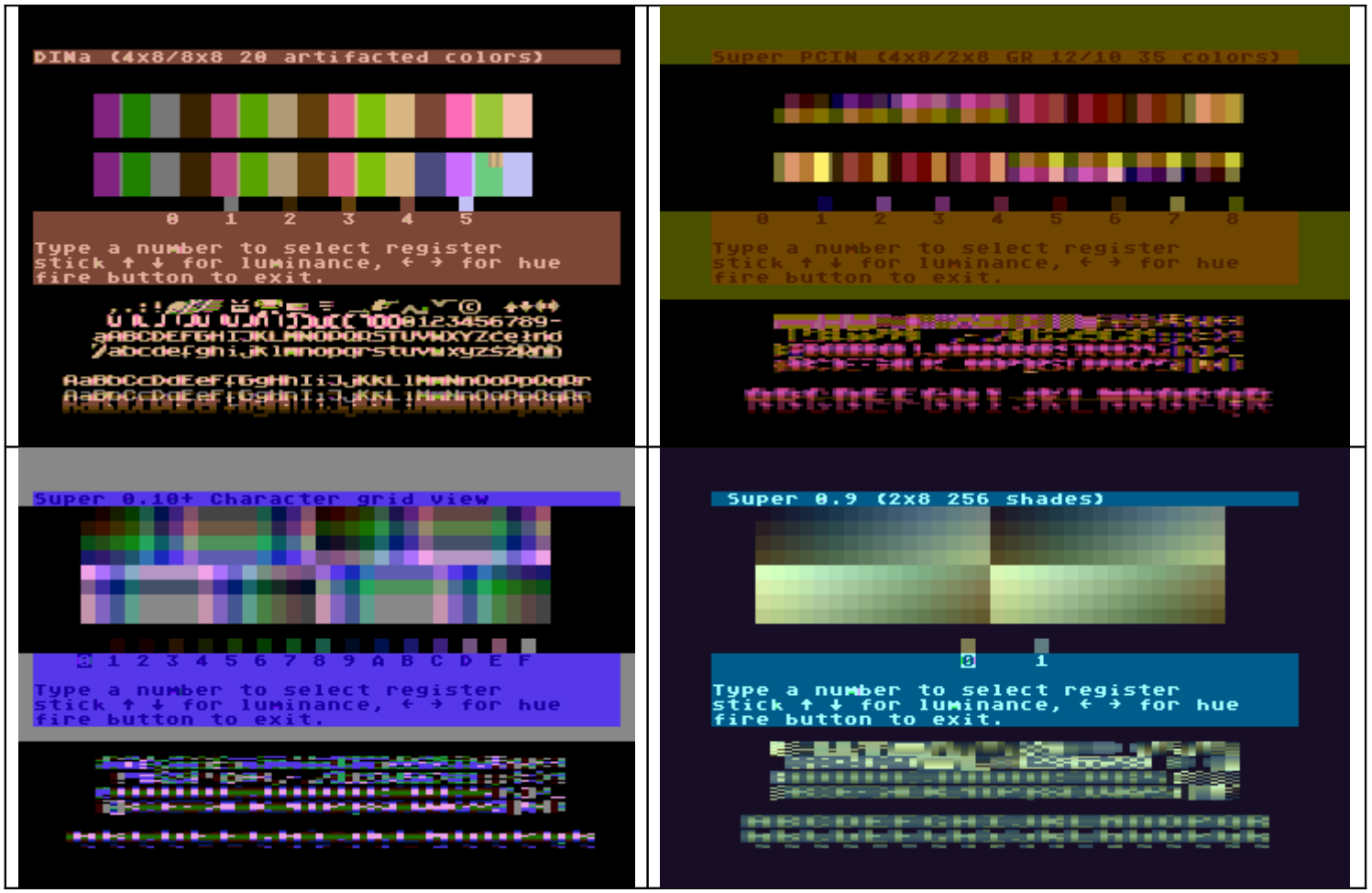
Palette Select
(ICE CIN and ICE GTIA only)



This function allows you to add colors to your drawing palette. A display showing the entire range of colors available in your current graphics mode will appear. In the CIN modes you see two displays, the top is the normal color palette while the bottom is the inverse palette.

Use your joystick to cursor around the color display, and type 0-9 or A-F to add your selected color to the drawing palette. Here also, as in editing mode, CTRL-TAB will cycle your drawing palette so you can add more colors. Pressing the fire button on your joystick will exit this function and return you to the editing screen.

Color Tuner



This function allows you to set your color registers. To access this function, do Ctrl-C from the main edit screen. A color palette display will appear followed by a listing of the available color registers in your current display mode, and the hexadecimal numbers associated with each color.

Type in 0-9 or A-F to access the appropriate color register. Using your stick up and down changes the brightness aspect, while using your stick left or right changes the chroma (or hue) aspect. On some color registers, depending on your display mode, you will only be allowed to alter one aspect (luminance, or chroma).

Pressing your fire button will exit from this function and return you to the main editing menu.

Edit mask

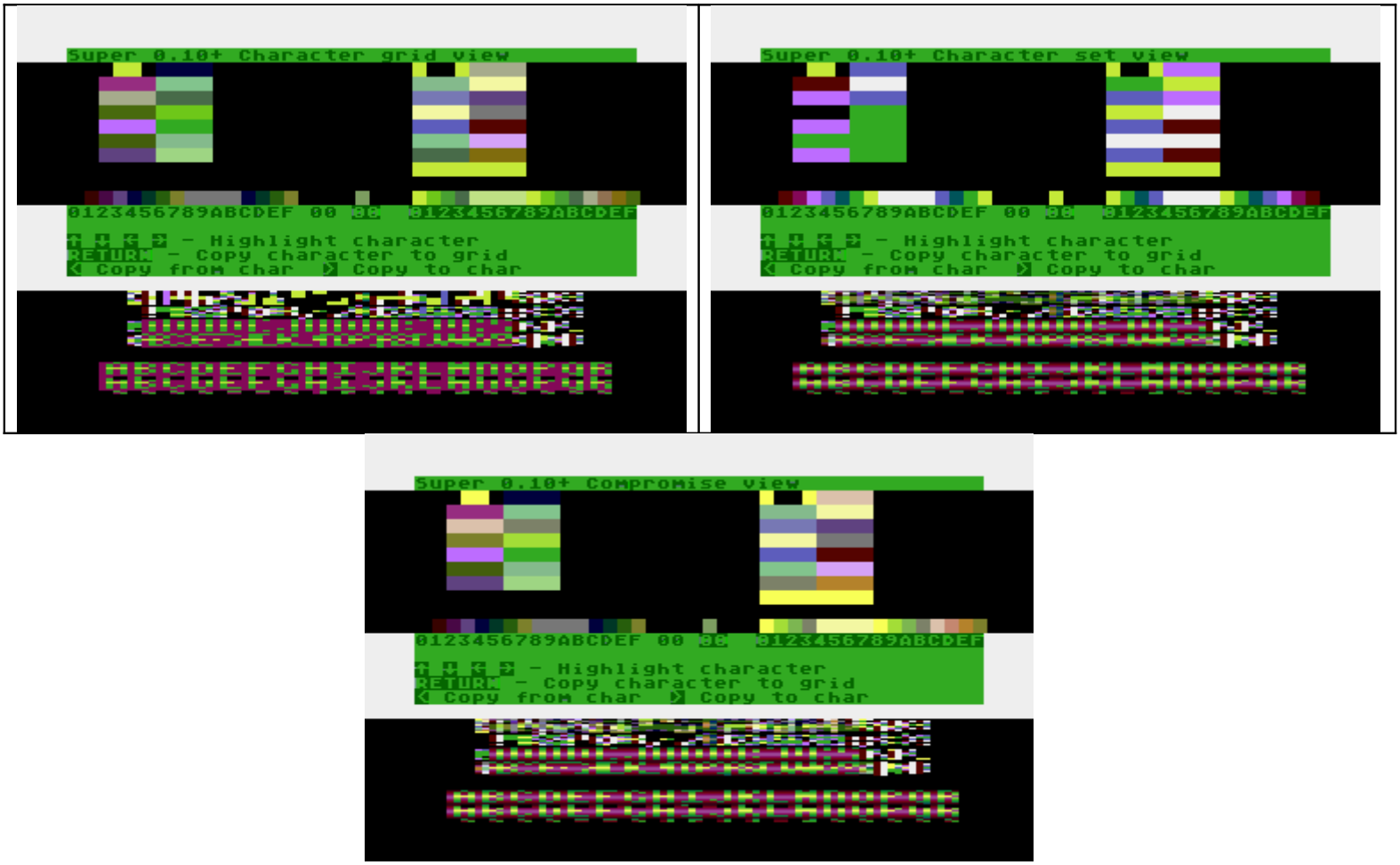
Each interlaced font you edit in ICE has two font masks, based out of two different 40 column text modes. It is possible to edit each individual font mask by typing Ctrl-E from the main menu. You will see the character grid for the individual font mask displayed, with the status area at the top showing the base Graphics mode for that mask. The example shown above is for the APAC mode, which is based on two Graphics 0 text modes: Graphics 0.9 (which is the GTIA 16 monochrome mode) and Graphics 0.11 (the GTIA 16 chroma mode).

In the example shown above, the display mode is CIN 12. You will notice that the color palette realigns itself according to the colors you can use in the base Graphics mode. In this example, Mask 1 is Graphics 12, which allows the 4 playfield colors (708-711, in this example monochrome), with 711 being shown only in the inverse grid. Mask 2 shows the color layout for Graphics 12.11 (Graphics 12 with the GTIA set to Graphics 11). You will also note that in Graphics 12.11, only 14 of the 16 colors can be used and are arranged differently in the inverse palette.

Any editing and other character functions (copy, paste, clear, etc.) will only affect the mask you are working on. Ctrl-E will cycle through both masks, and doing CTRL-E a third time returns you to normal (both masks) editing mode.

View for Graphics 10+

(ICE GTIA only)



The Super 10+ display mode increases your color count in Graphics 10 to 80 colors, by cycling 7 of the color registers every VBLANK (704-711). However, due to limitations by the ICE editor, it is not possible to see all these color combinations over the whole screen. The View function compensates for this by giving you selected views focused on either the character grid or the character set display. These are cycled by typing the "V" key in edit mode.

View 1 is the character grid view. It sacrifices color resolution in the character set display but allows you to see all 80 colors on the grid level.

This view is also automatically selected when you go into Palette Select or the Color tuner while in Super 10+.

View 2 is the Character set view. It sacrifices color resolution in the character grid, while showing you the full 80 colors in the character set display.

View 3 is a compromise view, which sacrifices slightly, the color resolution from both levels. Specifically color register 711 does not get cycled, which reduces your color resolution slightly but lets you edit on both levels.

When you save an ICE file (with the color data) in Super 10+, all the color register settings will be changed, regardless of which view you are in.

Copy Functions

Two copy functions are available: Copy from (accessible with the "<" key) and Copy to (accessible with the ">" key).

To use these, first highlight the character you want to copy to or from, in the character set display. Hitting "<" copies the character back to the character grid, and the data to the character you are currently editing. Hitting ">" copies the data in the grid to the character currently highlighted in the character set display.

This function also works on the mask level, in that only the data relevant to the font mask actually gets copied.

Currently in this version of the ICE editor, the Undo function will not work with "Copy To" so be careful. This will be addressed in a future release.

Editing functions

ICE has a selection of editing functions available:

Scroll character up and down
Mirror character
Inverse character
Blank character
Undo

Scrolling

This function is accessed by holding shift and pressing the up and down arrow keys, and will shift your character up or down by one scan line.

Mirror

This function produces a mirror image of your character. Typing M will do a horizontal mirror, while Control-M does a vertical mirror.

Inverse

This reverses the bit order of your character, similar to hitting the inverse video key in Graphics 0. In multi-color modes such as APAC or the CIN modes, it will reverse the ordering of colors in your character,

Blank

This erases the character currently in the editing grid

All of these functions will also work on the mask level, only affecting the mask being edited.

Undo

If you make a mistake, Undo will restore the character from the last action you performed (except for Copy To). There is only one level of Undo currently in the ICE editors. Future releases may increase this.

Miscellaneous functions

ICE also has the following miscellaneous commands available:

Cycle palette
Cycle menu
Toggle Graphics mode

Cycle Palette

(ICE CIN and ICE GTIA only)

CTRL-TAB will cycle your drawing palette through the available 64 colors, allowing you easier access to your drawing colors.

Cycle Menu

For your reference, the menu functions are displayed on the menu area of the screen, below the character editor, and can be cycled by hitting TAB. Note: in some modes (for example, Super 10) changing the color settings may affect the readability of this menu.

Toggle Graphics Mode

Typing “G” cycles through the various Graphics modes available in your editor. Note that if you change the color settings in color tuner or through loading an ICE file, the color settings for your particular mode are remembered and will be displayed again when you cycle back to it.

DISK IO functions

ICE will save and load fonts in the following formats:

.FNT – Standard 1024 byte font which can be loaded or saved from either of the two font masks

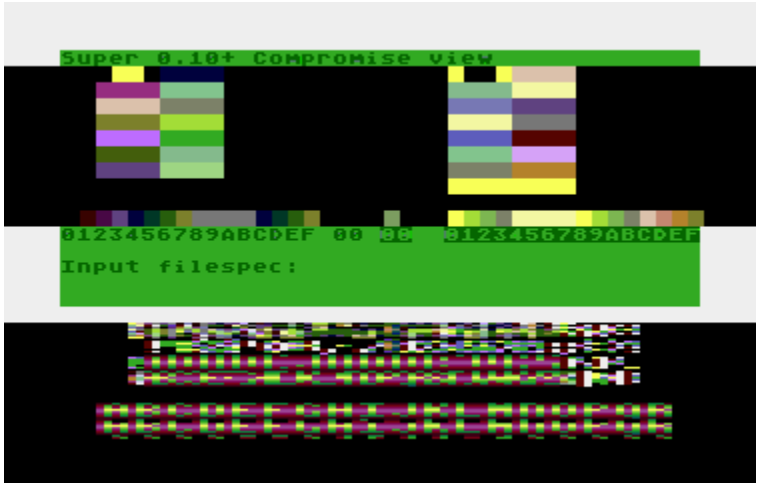
.FN2 – A 2048 byte double font comprising both font masks, which does not save any color data

.ICE – a custom format which saves the Graphics mode info, color register settings, and both font masks.

Load

By typing “L” from the edit menu, you are prompted whether you wish to save Font Mask 1, Mask 2, FN2 file, or ICE:

After selecting the appropriate function, you will be prompted for the filename:



The filename should be entered in DEV:FILENAME.EXT format, for example:

H:FONT.FN2
D:FONT.ICE
D2:FONT.FNT

The editor will attempt to load the font. If you attempt to load an ICE file created in a graphics mode unsupported in your editor you will be prompted with an error message. Otherwise, if the file cannot be found you will be returned to the editor.

Save file

You can select “S” from the main menu, and again, as above, you will be prompted to save Mask 1, Mask 2, FN2 or ICE file.

Future versions

I plan to add more features to this editor as time goes along, including:

Error checking for disk functions
Editing Super 0, DIN, and CIN/MIN/PCIN 0 in non artifacting mode (8 pixels across)
Dithering of characters for Super IRG and Super 10
Program to convert ICE files into BASIC code.

I am also planning a new font editor, for editing in interlace modes based on Graphics 1 and 2.

Appendix: Documentation of ICE format

For this documentation, the following terminology is used:

Graphics modes:

Graphics 0 refers to the ANTIC 2 (8x8 pixel 2 color) display mode
Graphics 12 refers to the ANTIC 4 (4x8 pixel 5 color) display mode
Graphics 0.9, 0.10, 0.11 are Graphics 0 with the appropriate GTIA settings
Graphics 12.9, 12.10, and 12.11 are Graphics 12 with the appropriate GTIA settings. These have a lower color resolution that the Graphics 0 modes with GTIA settings.

Color registers:

Color registers 704 through 712 are used in these new display modes, though not all of them will be used in all modes. In instances where a VBLANK color register shift is used, an “a” or “b” is appended to the register location. For example, “709a” refers to register 709 (Playfield 1) in the first VBLANK instance, and “709b” refers to the same register on the second VBLANK cycle.

Some of these registers in certain display modes are limited to luminance or hue value only, and will be noted.

In addition, certain background registers are “paired” and are ideally kept to the same value to avoid screen flicker. For example, 704/712 represents a background register, with 704 and 712 set to the same value.

Part 1: Graphics mode identifier

0 – 31 decimal, referring to the following Graphics modes:

0 – Super 0
1 – Super IRG
2 – Super IRG 2
3 – DIN
4 – Super 10
5 – Super 10+
6 – Super 9
7 – Super 11
8 – HIP 0
9 – CHIP 0
10 – APAC
11 – CIN 0
12 – MIN 0
13 – PCIN 0
14 – CIN 12
15 – MIN 12
16 – PCIN 12
17 – Super CIN
18 – Super MIN
19 – Super PCIN

20-31 are reserved for future use.

Part 2: Color register data

The following bytes contain color register data, ordered as follows for each Graphics mode:

0 – Super 0: 709a*,709b*,710a*,710b*

1 – Super IRG: 712, 708, 709, 710, 711

2 – Super IRG 2: 712, 708a, 708b, 709a, 709b, 710a, 710b, 711a, 711b

3 – DIN: 710a*/712, 709a*, 708, 709b, 710b, 711

4 – Super 10: 704, 705, 706, 707, 708, 709, 710, 711, 712

5 – Super 10+: 704, 705a, 705b, 706a, 706b, 707a, 707b, 708a, 708b, 709a, 709b, 710a, 710b, 711a, 711b, 712

6 – Super 9: 712a**, 712b**

7 – Super 11: 712a***, 712b***

8 – HIP 0: 704/712a**, 705, 706, 707, 708, 709, 710, 711, 712b

9 – CHIP 0: 712a****, 705, 706, 707, 708, 709, 710, 711, 712b

10 – APAC: 712a**, 712b***

11 – CIN 0: 712b*****, 709*****

12 – MIN 0: 712/710**, 709*

13 – PCIN 0: 704/710a*/712a, 709a*, 705, 706, 707, 708, 709b*, 710b*, 711, 712b

14 – CIN 12: 712b***, 708, 709, 710, 711

15 – MIN 12: 712**, 708, 709, 710, 711

16 – PCIN 12: 704/712a, 705, 706, 707, 708, 709, 710, 711, 712b

17 – Super CIN: 712b***, 708, 709, 710, 711

18 – Super MIN: 712**, 708, 709, 710, 711

19 – Super PCIN: 704/712a, 705, 706, 707, 708, 709, 710, 711, 712b

Notes:

(*) – 709 is luminance only (0-14) and will display the same chroma as the corresponding 710 register

(**) – 712 is chroma only, should be set to an exact multiple of 16 (chroma *16 where chroma is 0-15)

(***) – 712 is luminance only (0-14).

(****) – In CHIP 0, 712 is luminance only (0-14). In addition, register 704 should always remain 0 (black).

(*****) – In CIN 0, 712b and 709 are luminance only (0-14). In addition, register 710/712a should always be set to 0 (black).

Part 3: Font data

Next are two 1024 byte fonts. The font data is collated as follows for each Graphics mode:

0 – Super 0: Graphics 0 / Graphics 0
1 – Super IRG: Graphics 12 / Graphics 12
2 – Super IRG 2: Graphics 12 / Graphics 12
3 – DIN: Graphics 0 / Graphics 12
4 – Super 10: Graphics 0.10 / Graphics 0.10
5 – Super 10+: Graphics 0.10 / Graphics 0.10
6 – Super 9: Graphics 0.9 / Graphics 0.9
7 – Super 11: Graphics 0.11 / Graphics 0.11
8 – HIP 0: Graphics 0.9 / Graphics 0.10
9 – CHIP 0: Graphics 0.11 / Graphics 0.10
10 – APAC: Graphics 0.9 / Graphics 0.11
11 – CIN 0: Graphics 0 / Graphics 0.11
12 – MIN 0: Graphics 0 / Graphics 0.9
13 – PCIN 0: Graphics 0 / Graphics 0.10
14 – CIN 12: Graphics 12 / Graphics 12.11
15 – MIN 12: Graphics 12 / Graphics 12.9
16 – PCIN 12: Graphics 12 / Graphics 12.10
17 – Super CIN: Graphics 0 / Graphics 12.11
18 – Super MIN: Graphics 0 / Graphics 12.9
19 – Super PCIN: Graphics 0 / Graphics 12.10